

Agenda

- Project Status Overview
- Pearl Highlands Facility Flood Assessment
- Waipahu Station Flood Assessment
- Questions and Answers

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Honolulu Rail Transit Project

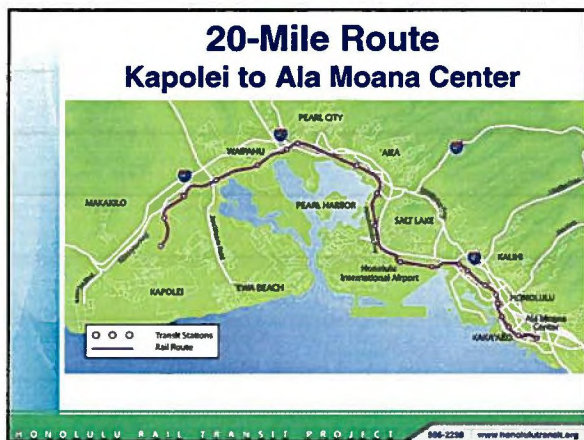


Pearl Highlands & Waipahu Transit Center Hydraulic and Flood Analysis

Presented to DPP
September 23, 2009

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Decisions Made

- December 22, 2006
- City Council selected fixed guideway in exclusive Right-of-Way
- Known as the Locally Preferred Alternative (LPA)
- Established route, elevated guideway in downtown

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Decisions Made

- **Transit Mode**
 - Fixed guideway in exclusive Right-of-Way
- **Alignment**
 - Now – East Kapolei to Ala Moana Center
 - Future – Kapolei to UH Mānoa and Waikīkī
- **Vehicle Technology**
 - Steel wheel on steel rail – “Light Metro”
 - Widely used, durable, cost-effective

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What Could It Look Like?



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Waipahu Transit Center Station



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Project Schedule

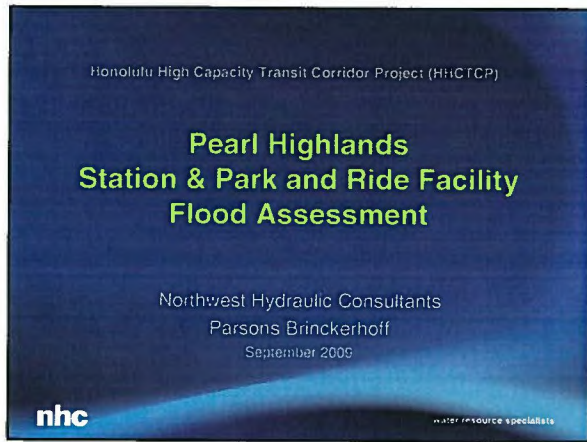
- Late Summer 2009: Release of Final EIS
- Fall 2009: FTA issues Record of Decision
- December 2009: Groundbreaking
- Late 2012: Service opens in phases, beginning in Waipahu
- Spring 2019: Start full service

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Project Schedule

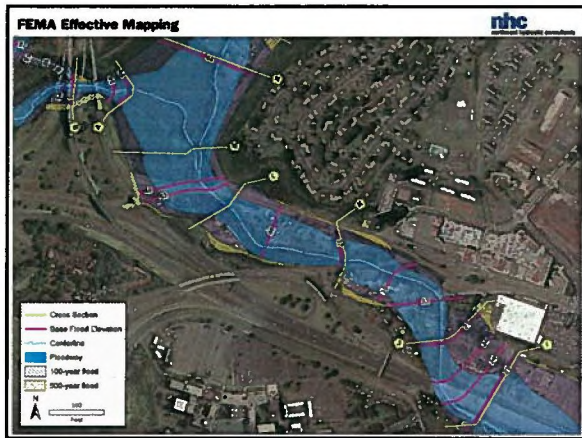


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Need for 2D Hydraulic Analysis

- Complex flow patterns
 - Bridges – *skew, piers, debris, approach fills*
 - Proposed Structures – *fills, piers, grading*

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Model -- FESWMS 2D

- Widely accepted public domain model
 - Developed for FHWA -- *bridges and structures*
- FEMA approved Model
 - Future FEMA map updates
 - Flood relief possibilities

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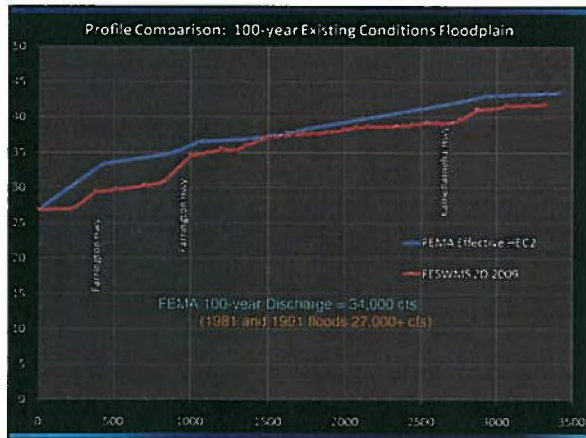
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Model Development

- Extent: H-1 -- Kamehameha highway
- Geometry: Lidar and new stream surveys
- Calibrated:
 - HWM's from 1991 major flood
 - HWM's from 2008 bank full flood

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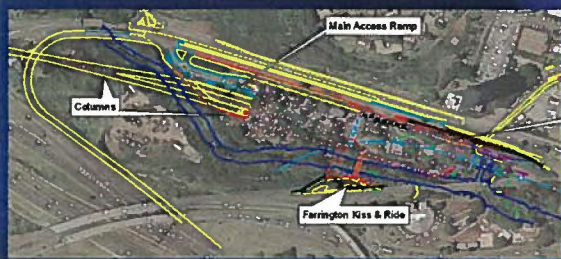
Floodplain Regulation Compliance

- Zero-rise 100-year floodway water levels

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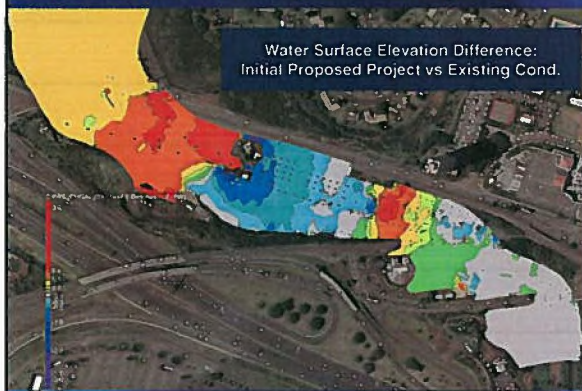
Initial Project Configuration



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Impacts of the Initial Project – Pre-mitigation

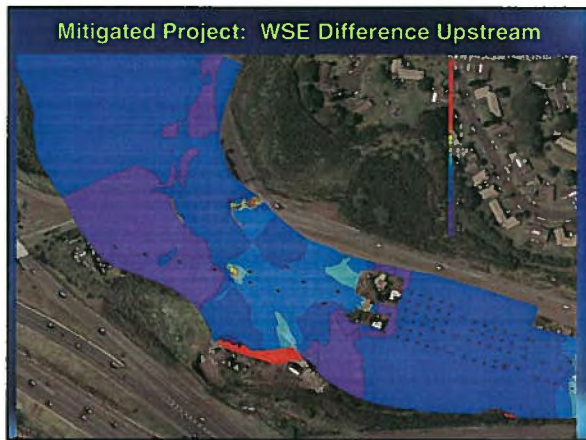


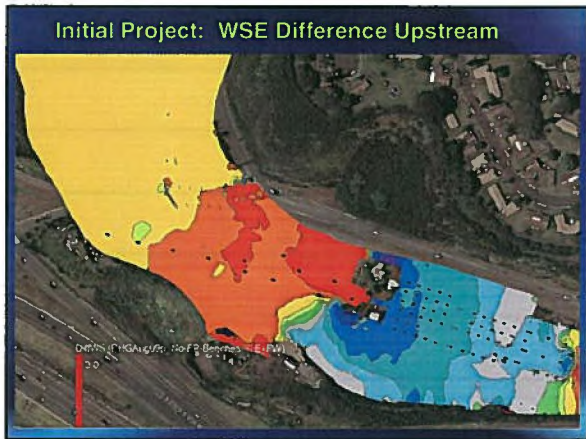
Elimination of Impacts

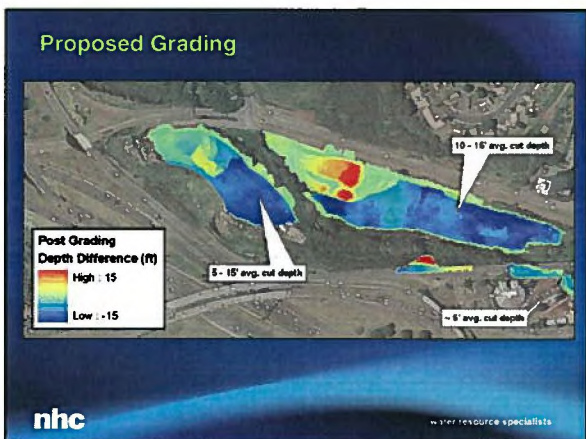
- Team Modified Design of Facility
 - Elevated key areas on columns
 - Set low chord of ground floor above 100-year level
 - No shear walls obstructing flow
- Floodplain Grading
 - Focus -- restore natural floodplain by removing fill

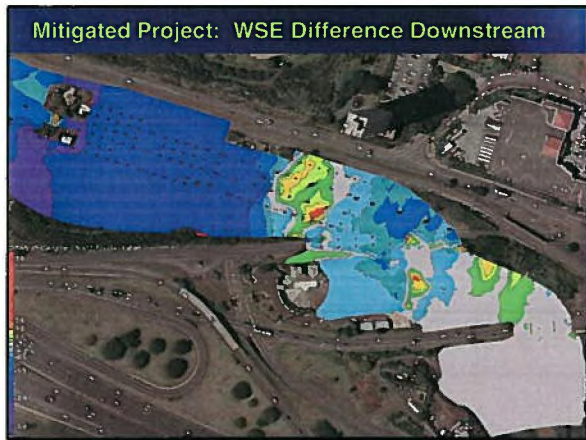
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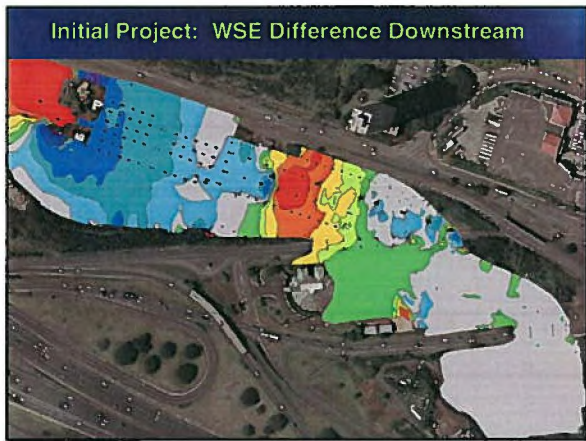
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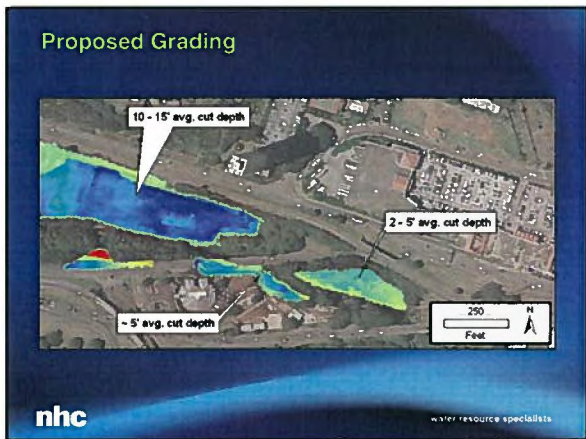




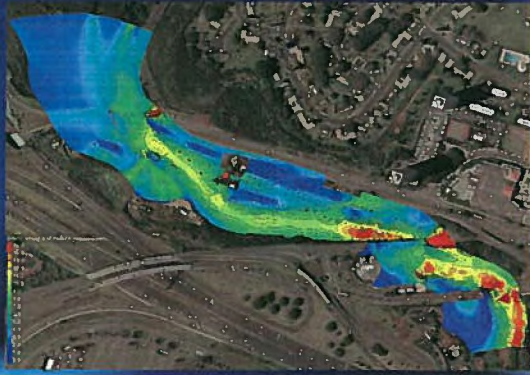




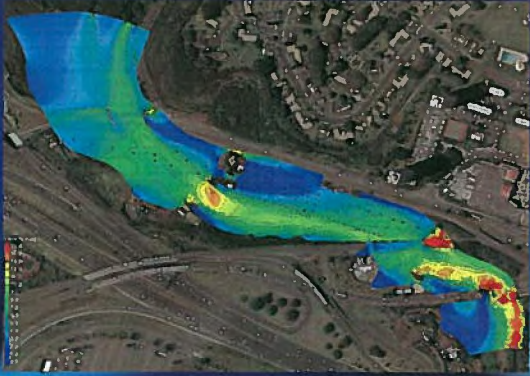




Velocities -- Existing Conditions



Velocities -- Proposed Project



Summary

- Design thoroughly considers flood issues
- Compliance with Flood District Regulations
 - Zero Rise within FEMA Floodway
- Restores natural floodplain function
- 2D model will aid in future design efforts and can be used by City for future activities



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WATER RESOURCE SPECIALISTS

Honolulu High Capacity Transit Corridor Project (HHCTCP)

Waipahu Flood Assessment

Northwest Hydraulic Consultants & Parsons Brinckerhoff
September 23, 2009



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FEMA Flood Zones



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Waialeale Stream



USGS weir at Farrington Hwy

Waipahu Cultural Garden Park

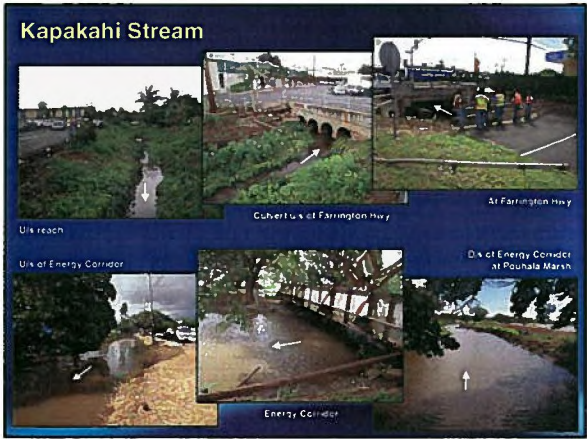
Levee overtopped during Dec 2003 flood

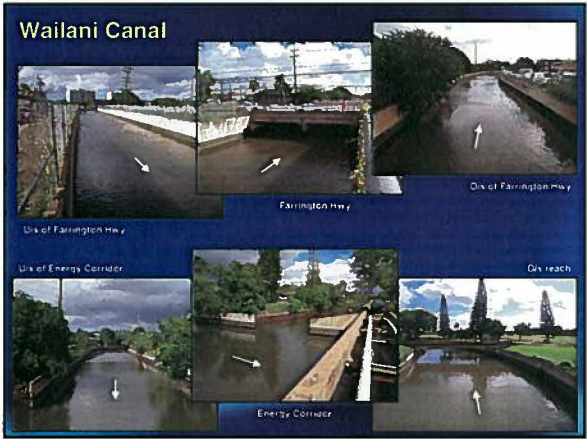


Carrington Hwy

Flood control channel div. at Farrington Hwy

Energy Corridor





1-D HEC-RAS Models of Study Streams

Models developed

- Waikole Stream (1.1 miles)
- Kapakahi Stream (1.2 miles)
- Wailani Canal (1.2 miles)

Purpose

- Determine flow split on Waikole Stream
- Estimate in-channel capacity
- Determine local effects of hydraulic structures

Data sources

- Cross-section & levee profile survey data (ControlPoint 2009)
- FEMA's cross-sections of Farrington Hwy (Park Engineering 2003)
- 100-year design inflow hydrographs (NHC 2009)

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100-Year Peak Flows

Stream	100-year flood peak flow (cfs)	
	NHC	FEMA (2004)
Waialele Stream below H-1 Freeway	25,306	26,000
Waialele Stream below Farrington Hwy		
(with levee)	20,100	N/A
(no levee)	11,500	15,300
Overflow from Waialele Stream		
(with levee)	4,990	N/A
(no levee)	13,900	11,971*
Kapakahuli Stream (local drainage)	847	N/A
Waiiani Canal	2,681	N/A

* Includes Waialele Stream overflow and Kapakahuli Stream local drainage


HEC-RAS

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FLO-2D Model

Model overview

- 2-d model that simulates complex overland flows including urban flooding
- Models spatial distribution of depths & velocities
- Accounts for interaction of multiple flow sources & flow paths on complex floodplains & in channels
- Unsteady flows (hydrographs)
- Floodplain storage loss & flow obstruction due to buildings
- Approved by FEMA

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FLO-2D Model of Waipahu Area

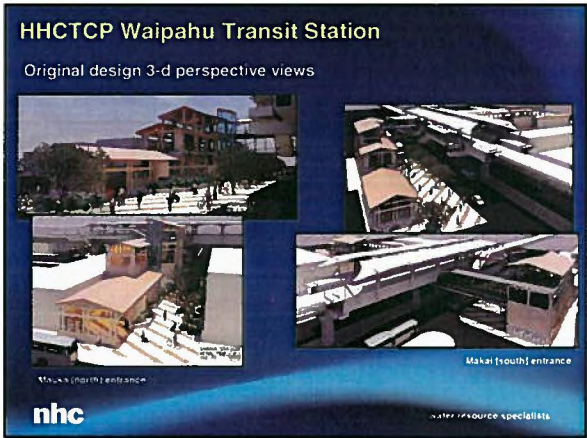
Models developed

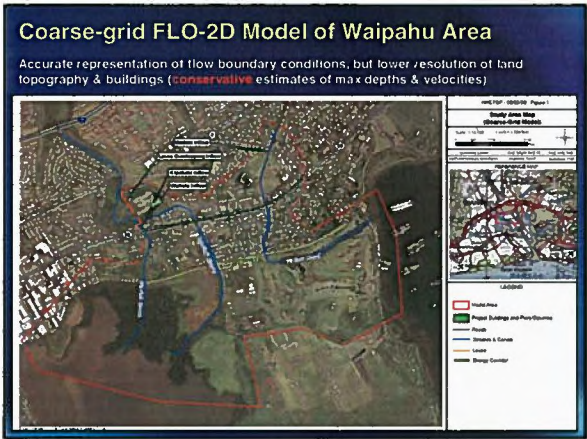
- Primary area-wide **coarse-grid** model (50 ft grid cell size)
- Supporting **fine-grid** model (10 ft grid cell size) in vicinity of project stations

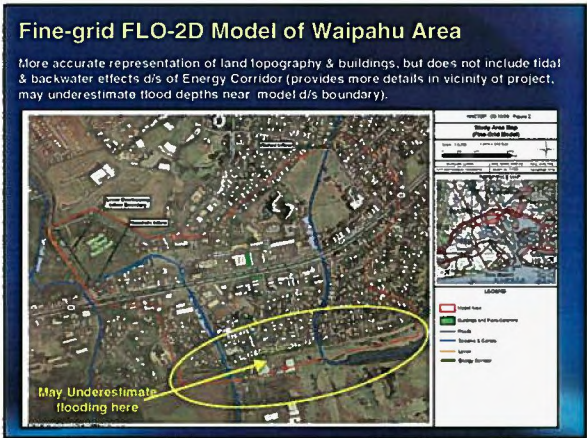
Data source

- 1 ft contour topography within HHCTCP corridor (JCLS 2007)
- 5 ft by 5 ft grid LiDAR data (FEMA 2006)
- Building locations & footprints (City of Honolulu)
- USGS 2004 aerial imagery
- 100-year design hydrographs developed by NHC (from hydrologic analysis & HEC-RAS simulations)
- Project features (PB)

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FLO-2D Model of Waipahu Area

Modeling scenarios

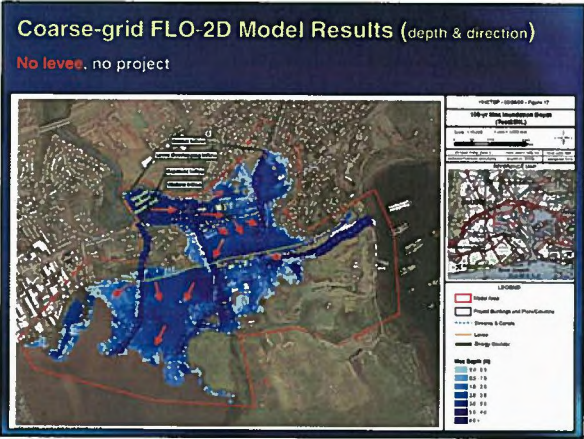
- With levee, no project
- With levee, with project
- No levee (FEMA's regulation), no project
- No levee (FEMA's regulation), with project

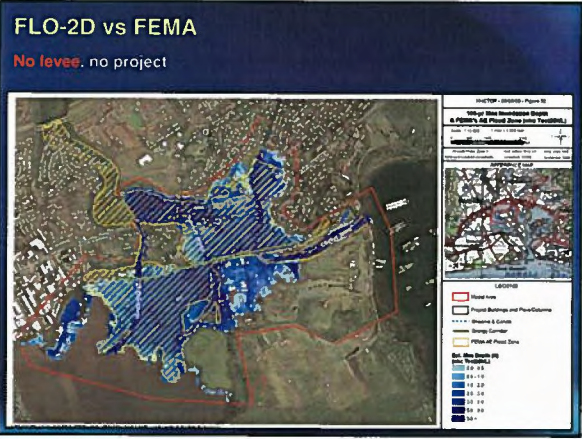
Project alternatives

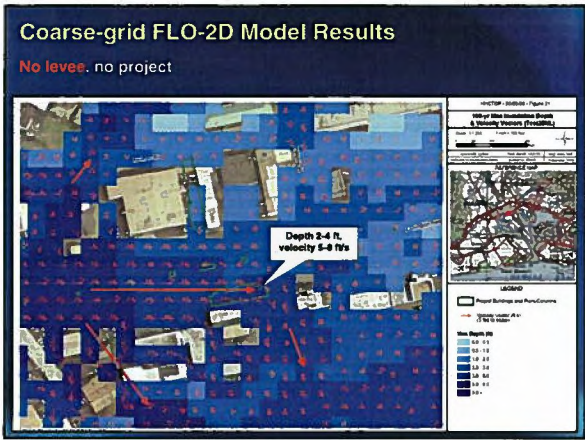
- Original project (2 entrance buildings & guideway support columns)
- Mauka (north) entrance building & guideway support columns, no makai (south) building
- Mauka (north) entrance building, makai (south) building on piers & guideway support columns

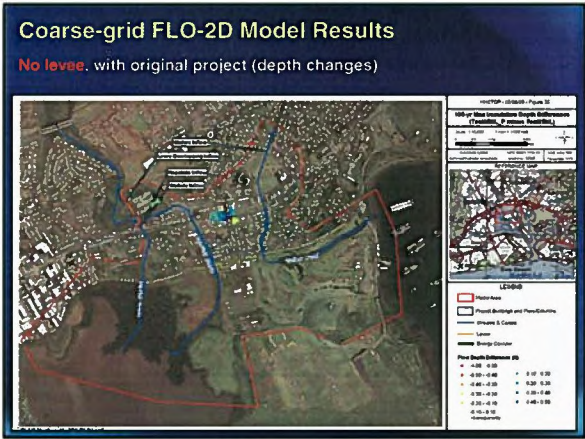
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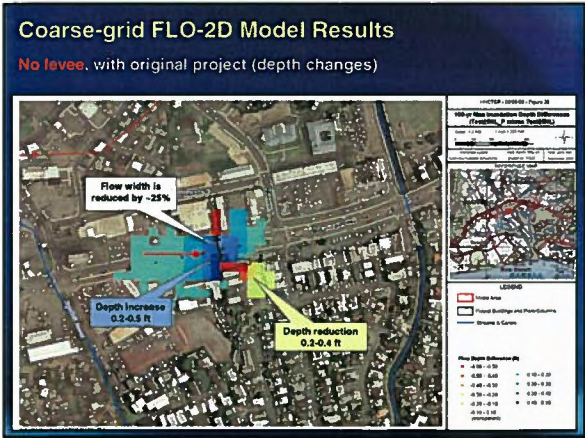
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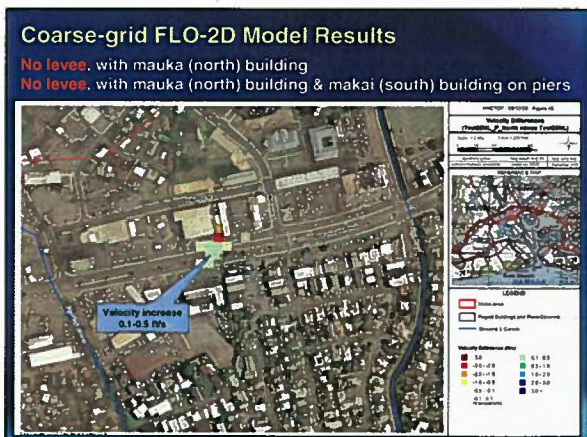
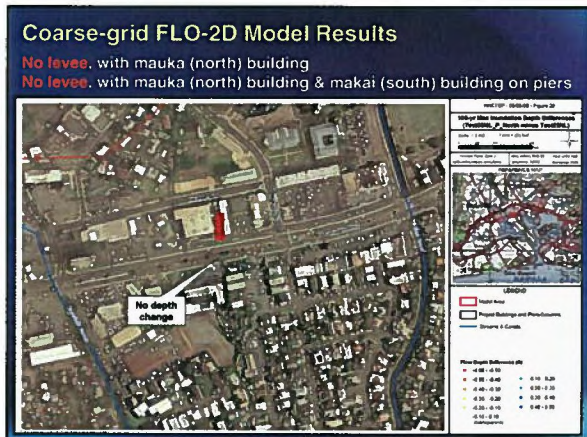
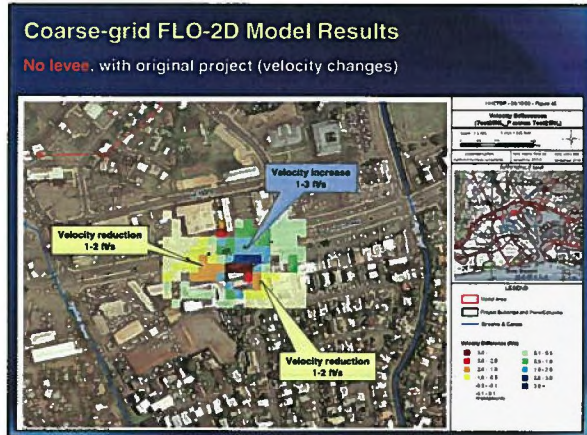


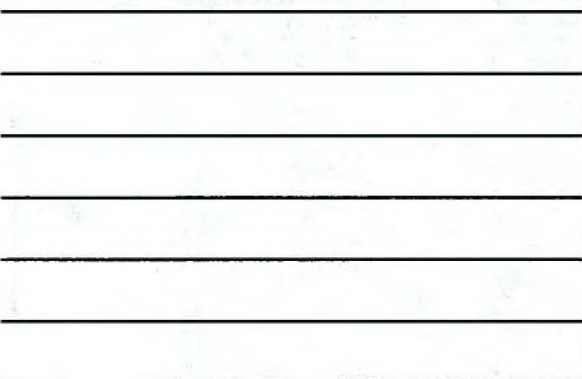
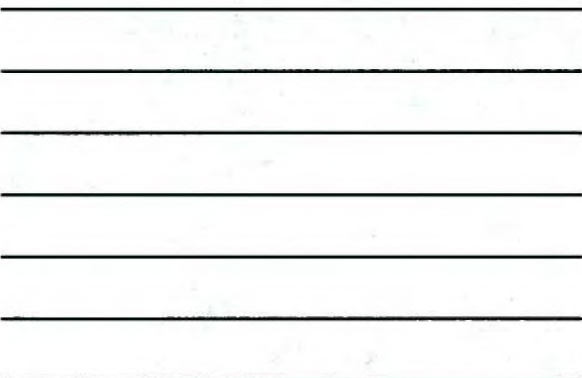
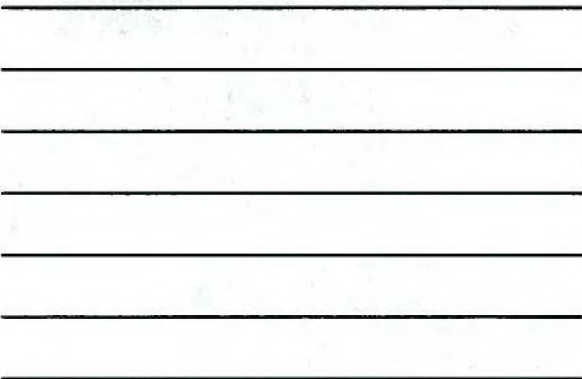












Summary

- 100-year flood event will cause significant overland flooding in Waipahi Town area for both with levee & without levee conditions
- Simulated max inundation depths in vicinity of proposed transit station are up to 1-1 ft for with levee & 2-4 ft for without-levee conditions
- Simulated max velocities are up to 3.5 ft/s for with-levee & 4-8 ft/s for without-levee conditions
- Original station design increases max inundation depths along Farrington Hwy by up to 0.2-0.5 ft
- Project impact is mainly due to obstruction to highly dynamic overland flows, reduction of local conveyance (~25%) along Farrington Hwy, as well as small reduction of floodplain storage
- Impact is mainly caused by makai (south) entrance building located in flow path
- Without makai (south) building or with this building placed on pier, project has no detectable impact on flood levels (within model accuracy of 0.1 ft)

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